



Environmental ALARA Program Plan

Revision 2
July 1, 2003

Ernest Orlando Lawrence Berkeley National Laboratory
Environment, Health, and Safety Division
Environmental Services Group

Prepared By: Linnea Wahl
Linnea Wahl, Environmental Services Group

Date: June 18, 2003

Reviewed By: Mike Ruggieri
Mike Ruggieri, Environmental Services Group

Date: 6-18-03

Approved By: Ron Pauer
Ron Pauer, Environmental Services Group Leader

Date: 6/18/03

1 ENVIRONMENTAL ALARA POLICY

It is the policy of Berkeley Lab to prevent any harm to the health and safety of the general public or to the environment as a result of the Laboratory's activities. Berkeley Lab is committed to good environmental management of all its potential risks, minimizing risks to the environment and public health, and anticipating and addressing potential environmental problems before they pose a threat to the quality of the environment or the public welfare (LBNL 2003a).

In keeping with this policy, Berkeley Lab is committed to keeping radioactive emissions and external exposures as low as is reasonably achievable (ALARA). The Berkeley Lab Environmental ALARA Program was developed and implemented to systematically verify and document that environmental radiological impacts are ALARA.

2 INTRODUCTION

ALARA is a radiation protection acronym that stands for "as low as reasonably achievable." The ALARA concept is an approach to managing and controlling exposures (both individual and collective to workers and the public) and releases of radioactive material to the environment, by considering social, technical, economic, and public policy factors. The ALARA concept is not a dose limit, but rather a philosophy that has the objective of maintaining doses as far below applicable limits as is reasonably achievable. We follow the ALARA philosophy when we seek to answer the question, "Have I done all that I can reasonably do to reduce radiation doses?" (DOE 1991).

At Berkeley Lab, the ALARA policy is implemented in several ways (LBNL 2003a).

- Workers who use radioactive materials and radiation-producing devices strive to reduce radiation exposures, waste, and environmental effluents.
- Each new facility or operation using radiation is subjected to reviews before there is a commitment to radiation work.
- ALARA work reviews are performed through Berkeley Lab's work authorization programs.
- The impact on the environment and public of Berkeley Lab's operations are reviewed, as described in this plan.

The purpose of the Berkeley Lab Environmental ALARA Program is to manage releases of radioactive material to the environment and exposures of members of the public to levels that are as low as reasonably achievable below applicable limits. The Environmental ALARA Program Plan is reviewed annually and revised at least every three years. In addition, environmental ALARA activities are discussed annually in the Berkeley Lab environmental report (LBNL 2003d) and in this way are communicated to Berkeley Lab managers and workers.

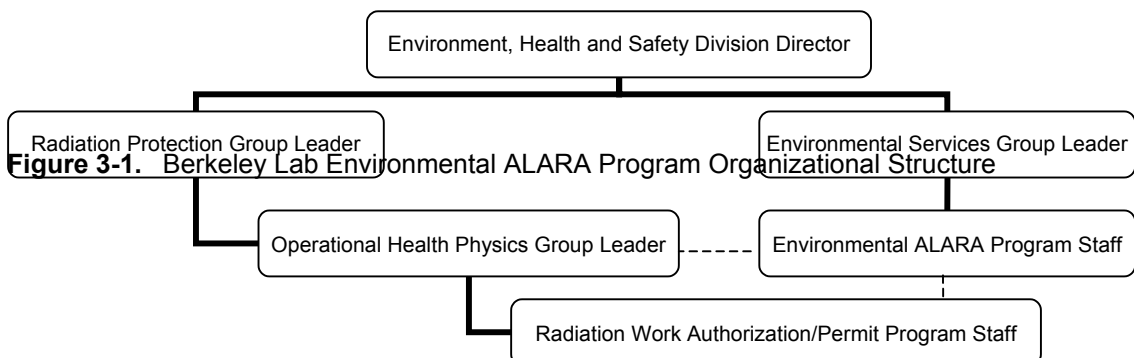
The Department of Energy (DOE) requires that the ALARA policy be implemented for all DOE activities and facilities that cause public dose, with no *de minimis* (DOE 1993). However, DOE guidance says that the ALARA policy should be applied in a graded manner and that activities with the potential to approach the DOE individual dose limit for the public (30 mrem for any single source or practice) should be identified and evaluated with a quantitative ALARA analysis (DOE 1997). Quantitative ALARA evaluations are not necessary for activities that have a potential for public exposure that is less than 1 mrem individual dose or 10 person-rem collective dose. Accordingly, the Environmental ALARA Program assesses radiological activities at Berkeley Lab qualitatively to determine if quantitative ALARA evaluations are necessary. Quantitative ALARA evaluations, when necessary, are performed in accordance with DOE guidance. All ALARA evaluations are documented.

3 ENVIRONMENTAL ALARA PROGRAM ORGANIZATION AND RESPONSIBILITIES

This section identifies and documents the organizational structure, responsibilities, and authorities of Berkeley Lab staff involved in the Environmental ALARA Program.

3.1 Organizational Structure at Berkeley Lab

At Berkeley Lab, an institutional environmental ALARA program is in place. Berkeley Lab programs do not establish individual environmental ALARA programs within their research areas. Figure 3-1 presents the organizational structure of the Environmental ALARA Program.



3.2 Responsibilities and Authorities for Environmental ALARA

At Berkeley Lab, scientific investigators, supervisors, and workers are responsible for following environmental laws and regulations (including the ALARA policy) and must be fully aware of the environmental impact of their own activities (LBNL 2003a). The Environmental Services Group of the Environment, Health, and Safety (EHS) Division has lead responsibility for the Berkeley Lab Environmental ALARA Program. Scientific investigators rely on the Environmental Services Group to assist them in accomplishing environmental compliance objectives, including implementation of the ALARA policy. The responsibilities and authorities for each environmental ALARA function are described below.

Environment, Health, and Safety Division Director: The division director has overall responsibility for the conduct of the environmental, health, and safety programs at Berkeley Lab, including the Environmental ALARA Program.

Environmental Services Group Leader: The group leader is responsible for environmental compliance and restoration activities at Berkeley Lab, including the Environmental ALARA Program. In addition to general oversight of the program, the group leader ensures that any necessary reports are generated and disseminated, and that staff in appropriate disciplines are available to support ALARA analyses and evaluations.

Environmental ALARA Program Leader: The program leader is responsible for managing the Environmental ALARA Program, which includes the following activities.

- Interface with Operational Health Physics Group to determine environmental emissions, source inventories, and external radiation requirements.
- Identify and evaluate site activities that have the potential for radiological impacts on the environment and the public.
- Support the Environmental Services Group Leader in maintaining this plan and implementing procedures.
- Establish and maintain records of environmental ALARA activities.

Radiation Protection Group Leader/Radiation Control Manager: The Radiation Protection Group Leader has responsibility for worker radiation protection programs at Berkeley Lab, filling the position of Radiation Control Manager as well. As Radiation Control Manager, he works with the Radiation Safety Committee to oversee facility and worker ALARA reviews.

Operational Health Physics Group Leader and Staff: This group manages several work authorization programs, including the Radiation Work Authorization Program and the Radiation Work Permit Program, and performs worker ALARA reviews. Analyses and information gathered are used by the Environmental Services Group to perform environmental ALARA evaluations.

4. ENVIRONMENTAL ALARA PROCESS

This section describes the steps taken to implement the environmental ALARA policy.

- 1) Identify site activities with the potential for environmental radiological impacts.
- 2) Review radiological impacts of activities.
- 3) Perform qualitative ALARA analyses to determine if quantitative ALARA analyses are required.
- 4) Perform quantitative ALARA analyses on activities with radiological impacts that warrant such review.

The first three steps are performed by staff in the Environmental Services Group and the Operational Health Physics Group as part of their routine functions. Data generated from these steps are provided to the Environmental ALARA Program Leader, who performs the final step (LBNL 2002, LBNL 2003b, LBNL 2003c, LBNL 2003d).

4.1 Identify Potential Radiological Impacts

Through facility ALARA reviews, each new facility or operation using radiation is subjected to reviews before any commitment to radiation work to ensure that radiation exposures to workers, the public, and the environment are ALARA. Through work authorization programs, worker ALARA reviews are conducted for all operations, practices, and procedures that have potential for high individual dose to workers. Facility and worker reviews culminate in reports such as safety analysis documents, activity hazard documents, radiation work permits, and radiological work authorizations (LBNL 2003a).

These reports are used by the Environmental ALARA Program Leader to identify activities with potential for radiological environmental impacts and that could require environmental ALARA analysis. All Class II and Class III (moderate- and high-hazard) authorizations issued by the Operational Health Physics Group are routed to the program leader for review and approval (LBNL 2002 and LBNL 2003b). The Environmental ALARA Program Leader's signature on authorizations communicates to scientific investigators, managers, and workers that any radiation exposures from authorized activities to the environment and public are ALARA.

4.2 Review Radiological Impacts

The Environmental Services Group reviews the radiological environmental impacts of the Laboratory and summarizes the results annually in the *Site Environmental Report*, which is available to Berkeley Lab managers and employees, as well as members of the public (LBNL 2003d). Radiological impacts to the environment and public from Berkeley Lab operations are due to accelerator and irradiator operations, air emissions, and sewer discharges. The Environmental ALARA Program uses the results from monitoring accelerator and irradiator operations, air emissions, and sewer discharges to assess the radiological impacts of Berkeley Lab activities.

The Environmental Services Group determines environmental radiological impacts from penetrating radiation produced by accelerator and irradiator operations using two methods: (1) a network of real-time environmental monitoring stations located around the site perimeter to track instantaneous gamma and neutron radiological impacts, and (2) a network of thermoluminescent detectors located near the site boundary and offsite to measure time-averaged doses from gamma radiation. The group estimates radiological impacts from accelerator and irradiator operations at Berkeley Lab annually and reports the results in the *Site Environmental Report* (LBNL 2003d).

The Environmental Services Group monitors radionuclides in stack and ambient air. Several air-sampling stations at Berkeley Lab monitor radionuclides in the ambient air, and the Environmental Services Group reports the results of this monitoring annually in the *Site Environmental Report* (LBNL 2003d). For facilities where radionuclides are handled, the group measures or calculates stack emissions and resulting doses to the public and reports them annually. Throughout the year, the Environmental Services Group reviews work authorizations for operations that have the potential to emit airborne radionuclides. Operations that have the potential to emit radionuclides to the environment that could result in an annual effective dose equivalent of 1×10^{-3} mrem or greater to the public are monitored using stack air sampling and analysis procedures that comply with the National Emissions Standards for Hazardous Air Pollutants (EPA 2003). Results of stack monitoring are reported in the *Radionuclide Air Emission Annual Report* (LBNL 2003c).

The Environmental Services Group samples Berkeley Lab's wastewater at two sewer outfalls and analyzes the water for radionuclides. The group reports the results annually in the *Site Environmental Report* (LBNL 2003d).

4.3 Perform Qualitative ALARA Analyses

Annually, the Environmental ALARA Program assesses the qualitative radiological impacts from Laboratory operations by performing a collective dose assessment that is communicated to scientific investigators, managers, and workers through the annual *Site Environmental Report*. Periodically throughout the year, radiological impacts of Laboratory operations are assessed when the Environmental ALARA Program reviews Class II and III (moderate- to high-hazard) work authorizations and determines individual dose to the public. The results of work authorization reviews are communicated to the Operational Health Physics Group.

4.4 Perform Quantitative ALARA Analyses

Based on qualitative ALARA analyses, individual projects that could cause the potential dose to the public to exceed 1 mrem (individual) or 10 person-rem (collective) are subjected to quantitative ALARA analyses using the steps described below. Since 1996, no operations or facilities at Berkeley Lab have resulted in an individual dose to the public greater than 1 mrem or a collective dose greater than 10 person-rem, the Department of Energy's thresholds for quantitative ALARA analysis (DOE 1997).

Quantitative ALARA analyses include societal, technological, economic, and public policy considerations. In addition, these ALARA analyses consider DOE guidance for performing the following environmental ALARA assessments (DOE 1997).

- Identify possible candidate radiation protection systems, such as alternative operating methods or controls, that are reasonably achievable. The options should range from the most rudimentary (base case) to the most technologically sophisticated systems.
- Quantify exposures and doses to individuals and populations in the vicinity of the activity for each candidate radiation protection system.
- Quantify the economic factors, including the costs of purchasing, installing, operating, and maintaining the radiological protection system equipment, and the potential health effects associated with the exposure of people and any other direct or indirect cost resulting from exposures to radiation.
- Identify and estimate other health and nonhealth detriments and benefits.
- Evaluate process alternatives using a quantitative cost-benefit analysis optimization, when possible. If evaluations include assumptions, judgments, and limitations that cannot be quantified, and potential doses are well below the dose limit, qualitative analyses can be used with full documentation.
- Select one of the candidate radiation protection systems.
- Implement recommendations of the ALARA analysis and monitor the results.

A checklist of the following specific factors is prepared for a quantitative ALARA analysis (DOE 1997).

- Maximum dose to members of the public
- Collective dose to the population
- Doses to workers
- Applicable alternative processes (treatments, operating methods, or controls)
- Doses for each alternative evaluated
- Costs for each alternative evaluated
- Changes in costs among alternatives
- Societal and environmental (positive and negative) impacts associated with alternatives

Additional information, checklists, or analyses may be required in accordance with DOE guidance for performing environmental ALARA evaluations (DOE 1997). Results of a quantitative ALARA analysis are provided to the scientific investigators leading the project. If the potential dose from a chosen ALARA alternative exceeds 10 mrem effective dose equivalent to any member of the public in a year or a collective effective dose equivalent of 100 person-rem in a year, DOE will be notified.

5. TRAINING

Based on recent estimates of dose to the public from Berkeley Lab operations, only qualitative ALARA analyses are normally required. Much of the data and analysis used for environmental ALARA evaluations is developed and documented by the Operational Health Physics Group as part of their routine work authorization processes.

The Environmental ALARA Program Leader is required to have the expertise to review and evaluate work authorizations for their application to the Environmental ALARA Program. In addition to expertise in radiation physics, the program leader must have knowledge of laboratory operations, radiological material handling, emission source characterization, radiation protection procedures, and dose modeling. These staff skills and qualifications for ALARA analyses are documented by Berkeley Lab's system of job classifications, which stipulates minimum personnel qualifications and experience levels.

If a quantitative ALARA analysis were to be performed, a broad array of disciplines might be required: computer modeling, dose and risk assessment, environmental monitoring and surveillance, engineering, environmental sciences, and others. Since one or two individuals may not have all of the requisite expertise for quantitative ALARA evaluations, discipline specialists should be available to support the Environmental ALARA Program Leader. In addition to Environmental Services Group staff, the following organizations may be requested to provide

support: Facilities Department, Operational Health Physics Group, and Waste Management Group.

The Environmental Services Group Leader and the Environmental ALARA Program Leader determine which areas of expertise will be required for a quantitative ALARA evaluation before the project is begun. If it is anticipated that staff with the required disciplines are not available, the Environmental Services Group Leader determines if supplemental training in specific technical areas is required.

6 RECORDS

Records will be kept to demonstrate that sufficient information was assembled and considered to support ALARA decisions. Records will be kept of actions taken to implement the ALARA policy in regulating exposures to the environment and members of the public, such as cost-benefit or other analyses performed for a quantitative ALARA assessments, and other factors that were important to the ALARA decision-making process. Qualitative and quantitative environmental ALARA analysis records are filed by the Environmental Services Group. Radiological work authorization and radiation work permit files are kept by the Operational Health Physics Group.

Information used and generated by the Environmental ALARA Program will be documented and stored according to Berkeley Lab's records management policies and procedures. Records will be retained in an organized file system so that they are protected and easily accessed when needed. All records created by this procedure are reviewed after three years for transfer to the Berkeley Lab archives as described in the Berkeley Lab Operating and Assurance Program Plan (LBNL 2000).

7 REFERENCES

- | | |
|-----------|---|
| DOE 1991 | U.S. Department of Energy, <i>DOE Guidance on the Procedures in Applying the ALARA Process for Compliance with DOE 5400.5</i> , Interim DOE Guidance (March 1991). |
| DOE 1993 | U.S. Department of Energy, <i>Radiation Protection of the Public and the Environment</i> , DOE Order 5400.5 (January 1993). |
| DOE 1997 | U.S. Department of Energy, <i>Applying the ALARA Process for Radiation Protection of the Public and Environmental Compliance with 10 CFR 834 and DOE 5400.5 ALARA Program Requirements</i> , draft DOE standard (April 1997). |
| EPA 2003 | U.S. Environmental Protection Agency, <i>National Emission Standards for Hazardous Air Pollutants</i> , 40 CFR Part 61 (July 1, 2003). |
| LBNL 2000 | Lawrence Berkeley National Laboratory, <i>Operating and Assurance Plan</i> , PUB-3111, Revision 7 (April 2000). |

- LBNL 2002 Lawrence Berkeley National Laboratory, *Radiological Work Authorization Program*, EHS Procedure 707, Revision 4, Operational Health Physics Group (May 2002).
- LBNL 2003a Lawrence Berkeley National Laboratory, *Health and Safety Manual*, PUB-3000 (May 2003).
- LBNL 2003b Lawrence Berkeley National Laboratory, *Radiation Work Permit Program*, EHS Procedure 705, Revision 6, Operational Health Physics Group (May 6, 2003).
- LBNL 2003c Lawrence Berkeley National Laboratory, *Radionuclide Air Emission Report for 2002*, Environmental Services Group (May 27, 2003).
- LBNL 2003d Lawrence Berkeley National Laboratory, *Site Environmental Report for 2002, Volume I*, LBL-27170 (2003).